# Mechanisms for the Automated Setup of Software-Defined Networks

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21. VDE/ITG Fachtagung „Mobilkommunikation“
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# Technologies and Partner

•OpenStandard Communication Protocols

•SDN – Software Defined Networks, OpenFlow, OpenStack
•Internet of Things (**IoT**), Industrie 4.0, OPC UA
•NGN: IMS (IP Multimedia Subsystem)
•Voice over IP (VoIP), Unified Communications (UC)
•Session Initiation Protocol (SIP), Presence Service
•Web RealTime Communication (WebRTC)
•All-IP Mobil Communication, LTE
•Critical Communications, TETRA – LTE
•Soft-PBX: SipXecs, OpenUC, Asterisk, FreeSWITCH
•Workflow-Integration of RTC

•Quality-of-Service-Mechanisms (QoS) for RTC
•IntServ, DiffServ, MPLS, IPv6
•Routing, Load Balancing, NAT
•Analysis of „VoIP-Readiness“, Security in VoIP-Systems

•Test of IP-based Communication Systems
•Conformity Tests, TTCN-3
•Interoperability Tests, Stress Tests

•Development / Integration of OpenStandard Network Elements
•Contributions to Open Source Projects

GROUPLINK
bcc
Hytera
COMNEON Commneon GmbH & Co. OHG
ICT Software Engineering Advanced Thinking
Auerswald
SIEMENS
ROHDE&SCHWARZ
DLR
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- Motivation
- Automated Setup in NaaS context
- Requirements of Automated Bootstrapping
- Alternative Configuration Protocols
- Architecture for the Configuration Point
- Future Work

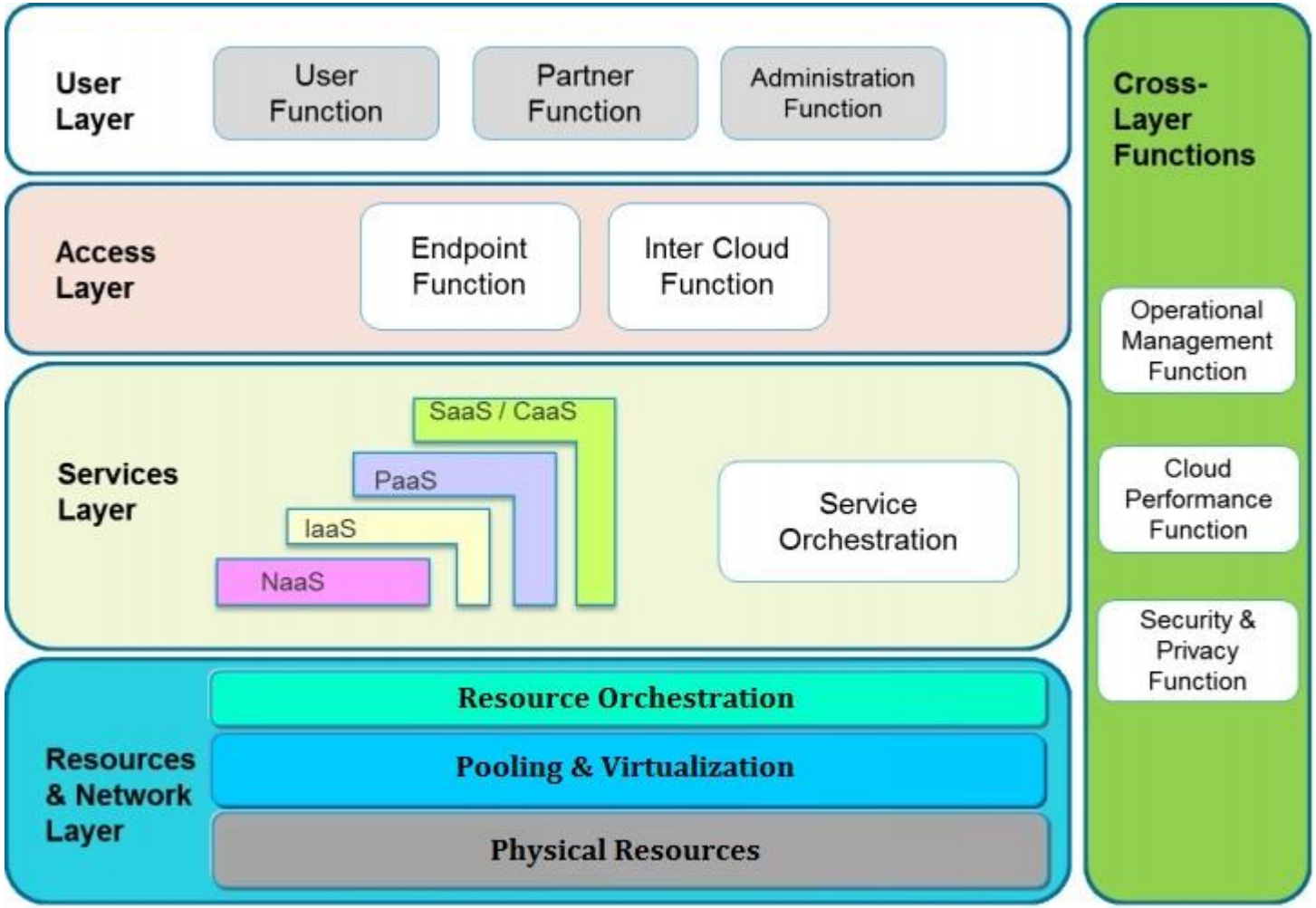
# Cloud computing makes IT applications efficiently! And the networks?

Complete networks automatically set up from the cloud?

First establishment of network elements according plug'n'play manner?

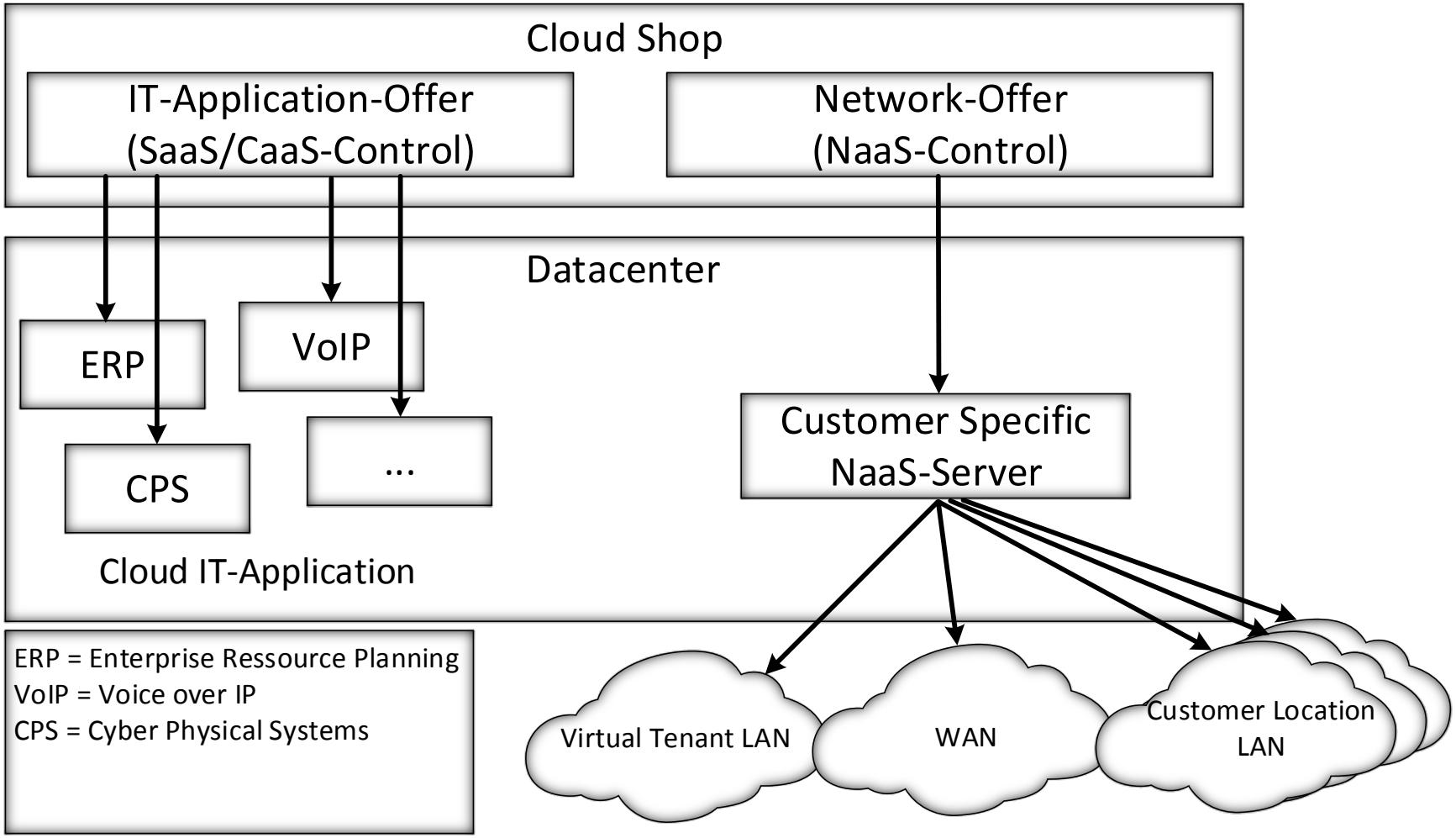
Standardized network configuration via a customer assigned NaaS server?

# Cloud-Layer nach der ITU-T




Quelle: ITU-T, „Focus Group on Cloud Computing, Part 5: Cloud Security, Version 1.0," 2012.

# Automated Setup in NaaS Context



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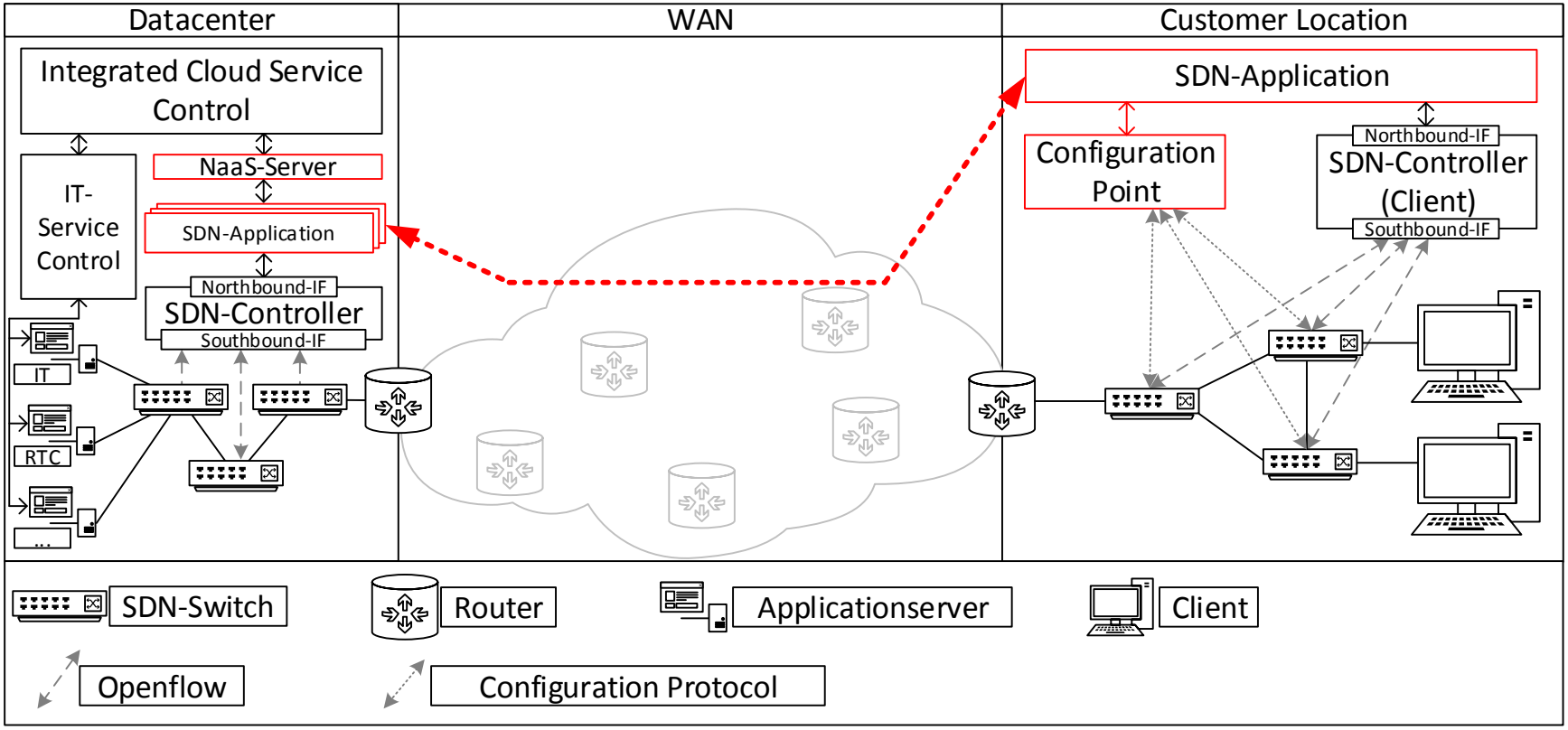
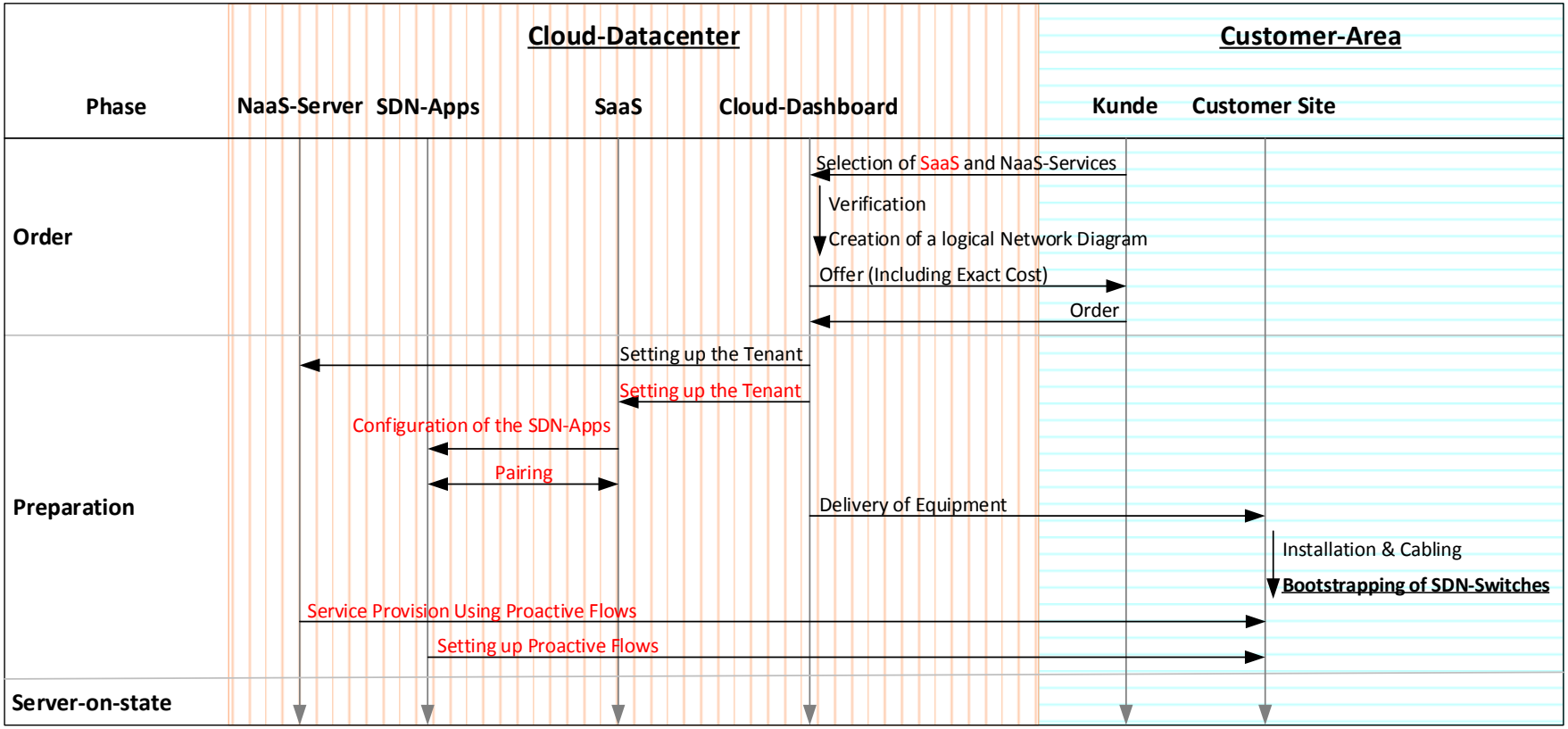


# Automated Setup in NaaS Context



# Requirements of Automated Bootstrapping

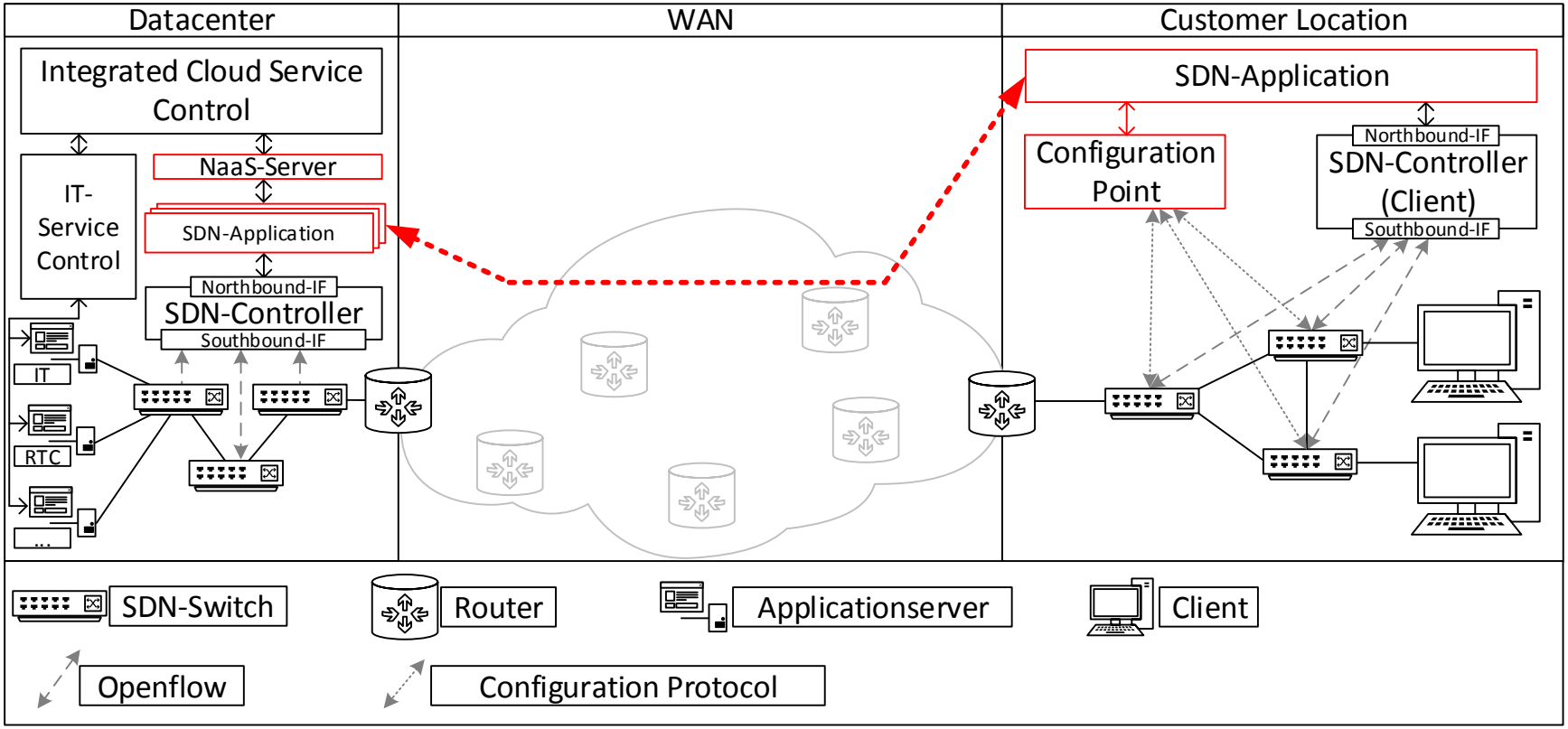
To be able to automate the initial setup of the SDN infrastructure, the respective protocols must fulfill the following set of requirements:

- A protocol should work out of the box
  - Implies that the protocol is enabled by default
  - Implies that the protocol does not need any additional manual configuration to function
- A protocol should be vendor agnostic
  - Network elements of different vendors should be interoperable in a heterogeneous scenario
  - This avoids the possibility for vendor lock-ins
- A protocol should be an open standard
  - Easily to implement
  - benefits the development of software libraries and APIs
- A variety of switches should support the protocol, this includes virtual and physical switches
- Manual work should only include the cabling
  - can be done by nearly anyone

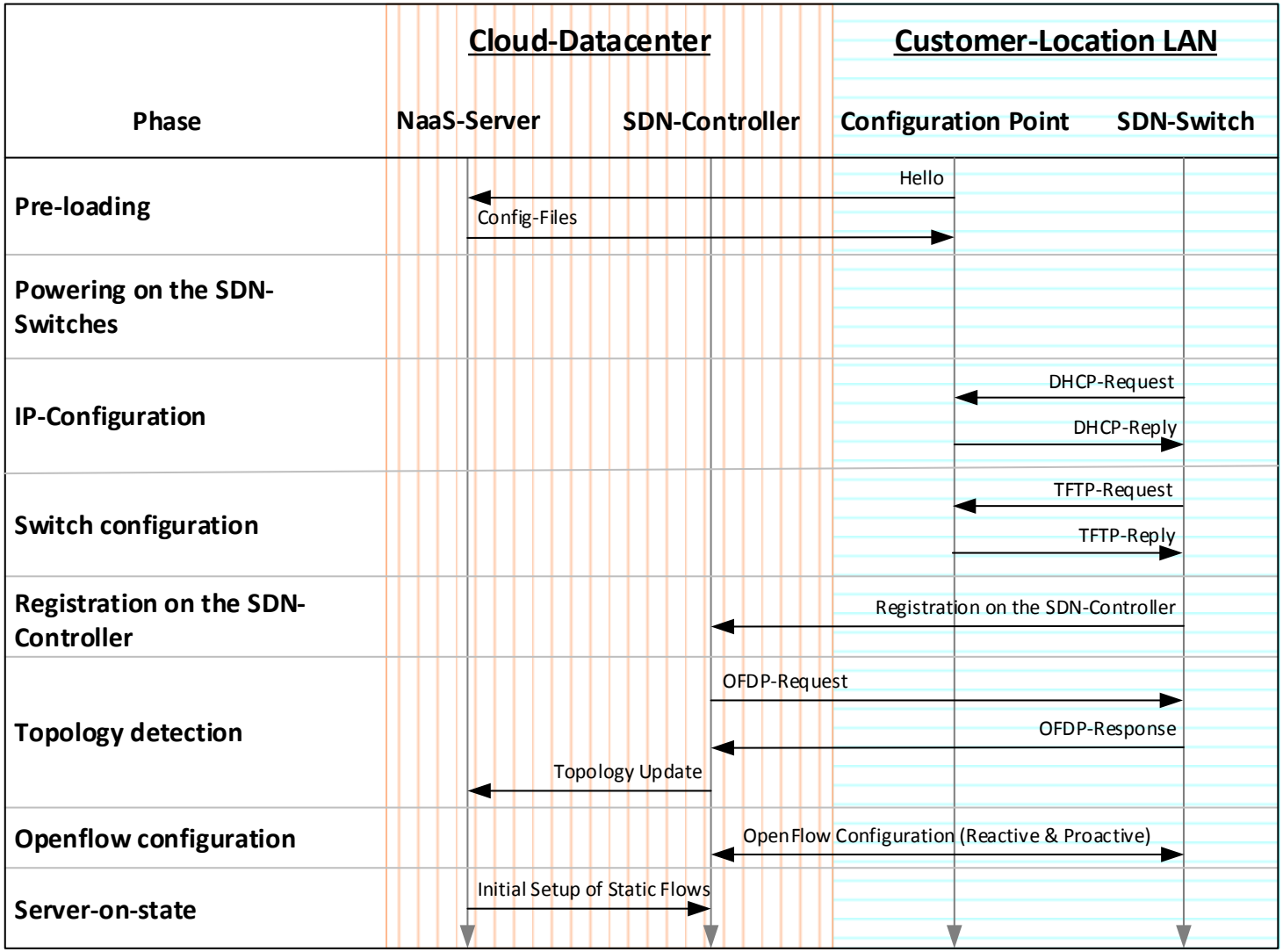
# Alternative Configuration Protocols

| | Importance | OF-Config | SSH | ZTP | Seriell | NETCONF | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 15 | - KO - | - KO - | 60,00% | - KO - | - KO - | | | | | | |
| Vendor support | 6 | 1 | Rarely supported | 10 | Standard | 4 | only implemented by bare metal systems or in premium hardware | 10 | Standard | 10 | Widely supported |
| Useable for bootstrapping | KO | N | Needs an IP address the availability of DHCP is not defined | N | Needs an IP address the availability of DHCP is not defined | J | Combination of DHCP and TFTP specifically designed for the boot strapping | N | Needs manuell wiring | N | Needs an IP address the availability of DHCP is not defined |
| Standardisation | 3 | 10 | ONF Standard | 3 | Depends on the used NOS | 5 | Depends on the used NOS | 2 | Depends on the used NOS | 8 | Depends on the used NOS |
| License Cost | 3 | 10 | None | 10 | None | 10 | None | 10 | None | 10 | None |
| Cost of implementation | 3 | 2 | High | 4 | Medium | 7 | Medium | 1 | High | 1 | High |

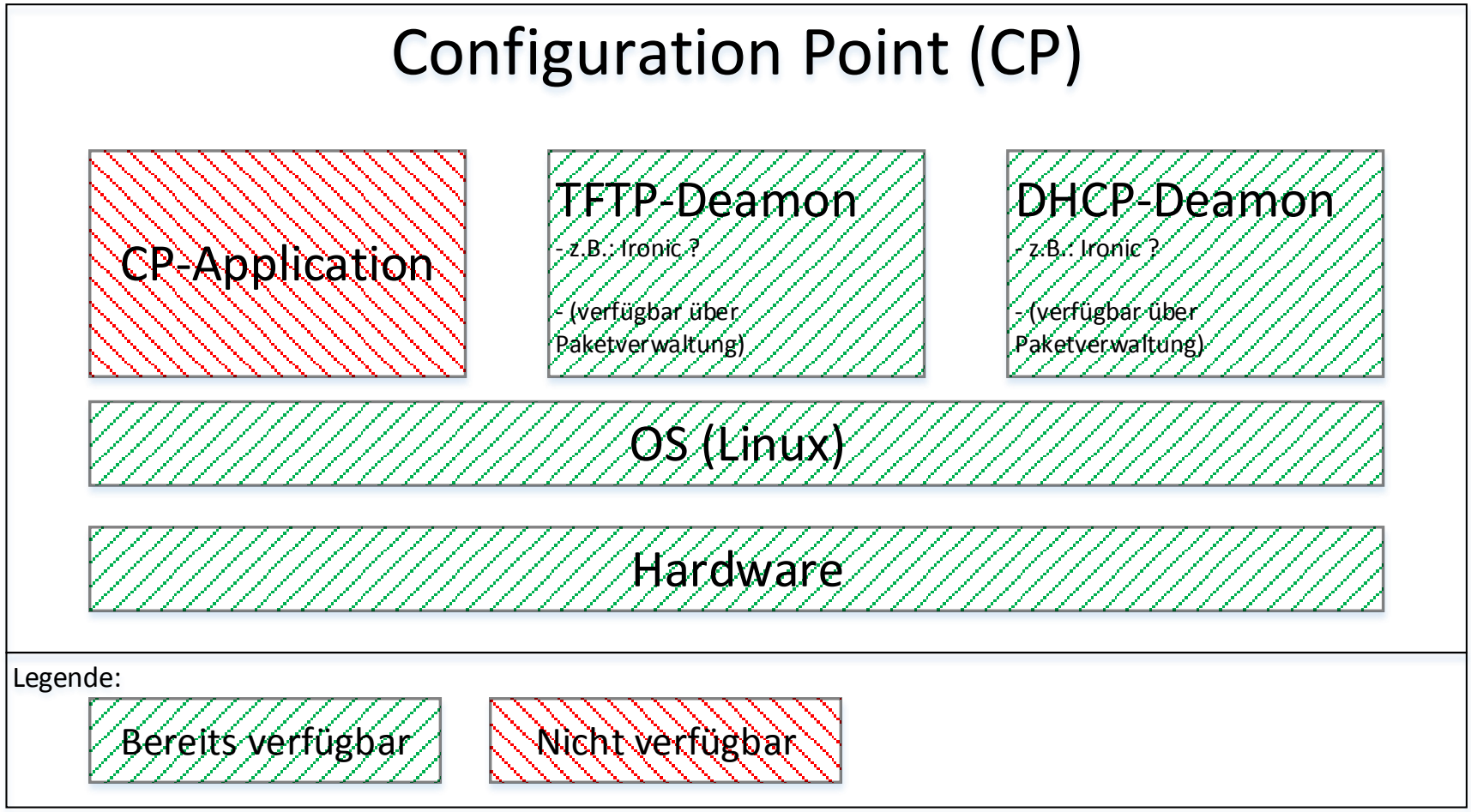
# Automated Setup in NaaS Context



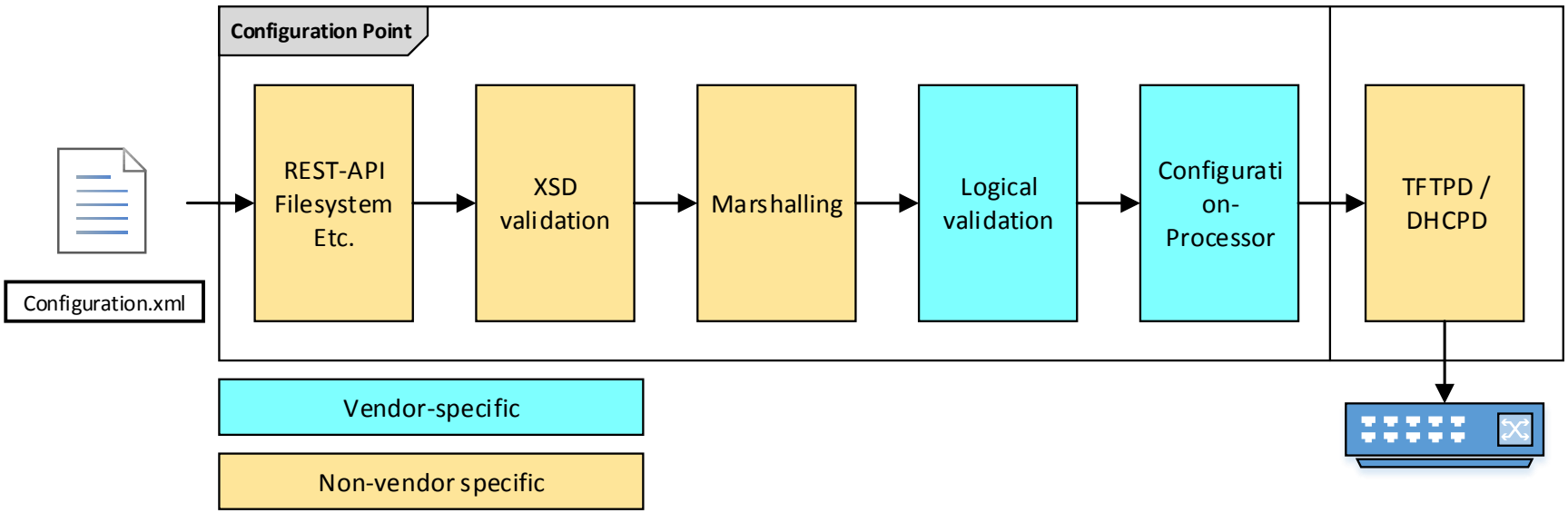
# Alternative Configuration Protocols



# Architecture for the Configuration Point



# Architecture for the Configuration Application



# Future Work

- Consideration of the 5G SDN Core Network Concepts
  - Methods for Management and Configuration of Data Plane Elements [e.g. 1]
  - Interrelations of Concepts
  - Integration of SDN-based WAN-as-a-Service Offerings expected within next years
- Analysis of OpenStack as XaaS/NaaS-Implementation Platform
  - Integration of NaaS-Concepts in Ironic?
  - Proof of Concept Implementation of SDN Apps for CaaS (VoIP) and CPS
- Analysis of Interrelation with OpenStack-based Application-oriented Frameworks like FIWARE

[1] Jose Costa-Requena et al., SDN and NFV integration in generalized mobile network architecture, 2015 European Conference on Networks and Communications (EuCNC), IEEE 2015.

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Discussion…